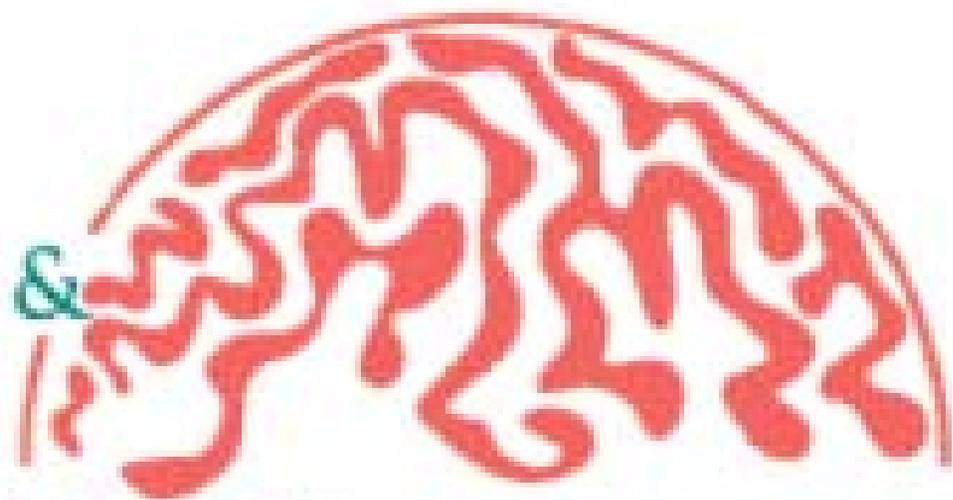


CDHC: Outbreak Event Response

Cheryl M. Woodley, PhD

NOAA NOS NCCOS
Center for Coastal Environmental Health and
Biomolecular Research
Hollings Marine Laboratory
Charleston, South Carolina

CORAL
DISEASE &
HEALTH
CONSORTIUM

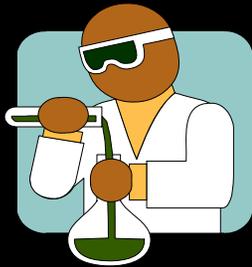


SOLUTIONS TODAY
FOR REEFS TOMORROW.

CDHC

Who are we?

Coral Disease and Health Consortium



**Non-Profit Research
Foundations**



UNIVERSITY



**State Govn'ts
& U.S.
Territories**



Industry



Coral Disease and Health Consortium

- Coral Biologists
- Ecology
- Environmental Microbiology
- Veterinary medicine
- Veterinary pathology
- Virology
- Aquatic Animal Health
- Toxicologists
- Histopathology
- Biochemistry
- Molecular Biology
- Cell physiology
- Human Medicine
- Biotechnology (Industry)
- Veterinary Diagnostics
- Resource Management
- Epidemiology

Vision:

- "To understand and address the effects of natural and anthropogenic stressors on corals in order to contribute to the preservation and protection of coral reef ecosystems."

research

**diagnostic
resources**

**specialized
resources**

CDHC Office

- 1. Communication**
- 2. Coordination**
- 3. Data integration**
- 4. Recommendations**

**environmental
data resources**

**epizootiologic
programs**

**education
resources**

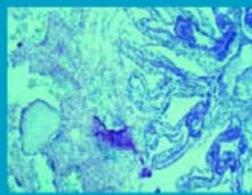
***Coral Health and Disease:
Developing a National Plan***

Objectives

- **Biology (6)**
- **Disease Identification and Disease Investigation (4)**
- **Disease Diagnostics (5)**
- **Environmental Factors Affecting Susceptibility and Infectivity (11)**

» **Summarized on pgs 64 & 65**

CORAL DISEASE AND HEALTH: A NATIONAL RESEARCH PLAN



National Oceanic and Atmospheric Administration
In Cooperation with Federal, State, Academic,
Non-profit Marine Laboratories and Industry Partners

August, 2003

Disease Agent

Host

Infectious

bacteria
viruses
fungi, protozoans

Noninfectious

genetic mutants
exposures
natural & anthropogenic

Plant
(algae)

Animal
(coral)

Basic
Biology

Functional
Genomics &
Proteomics

Histopathology
Genetics
Disease Dynamics
transmission mechanisms
In Vitro Culturing
Diagnostics
Mitigation, therapeutics

Susceptibility of host
Bioindicators

Biochemistry
Genetics
Physiology

Stress Response
Defense
Detoxification

Agent **Host**

Interactions

CDHC at Work...

- **Nomenclature**
- **Model System(s)**
- **Field Assessment of Coral Reef Condition**
- **Microbiology**
- **Toxicology**
- **Histopathology**
- **Molecular**
- **Bioinformatics**
- **Education and Outreach**

CDHC

What are we doing?

Research & Development

Coral Genomics

- EST sequences (~2500) for *Montastraea annularis*, *Porites porites* and *Oculina varicosa*
<http://www.marinegenomics.org/>
- Coral genome sequencing: *Porites lobata* & *Acropora palmata*
National Human Genome Research Institute
(G. Ostrander, PI)

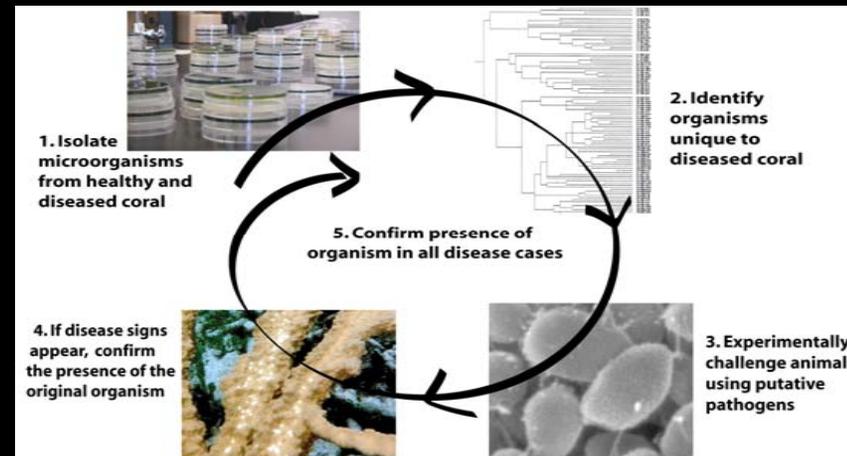
Diagnostic Resources

SETTING DIAGNOSTIC CRITERIA

Workshop with USGS National Wildlife Health Lab (Madison Wisconsin, April 2004)

Defined diagnostic criteria for selected syndromes including nomenclature and case definitions

http://www.nwhc.usgs.gov/Coral_Workshop/coral_workshop.html



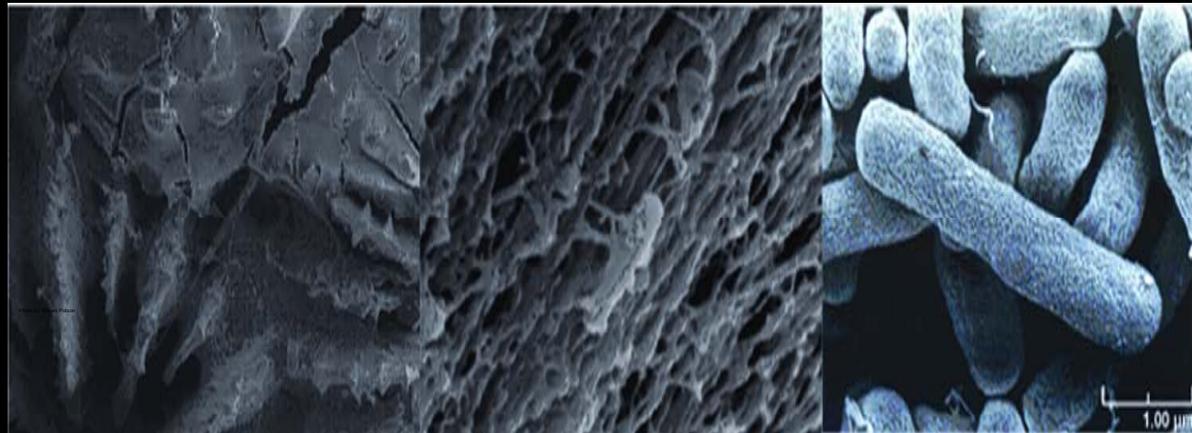
Diagnostic Assay Development

- DNA probe detect White Plague agent (Richardson et al) in freshly collected coral samples



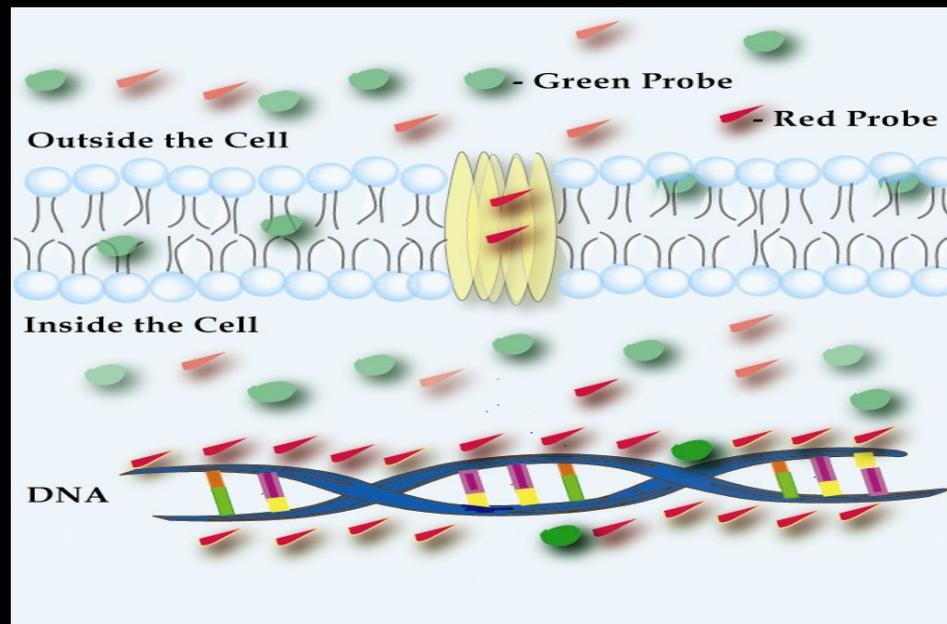
Diagnostic Assay Development

- **White Pox agent: DNA sequence analysis used to examine distribution**



Diagnostic Assay Development

- IMCOMP assay (coral immuno-competence)



Specialized Resources

International Registry of Coral Pathology (IRCP)

- **Repository of pathological material to facilitate the identification of disease etiologies and develop diagnostic criteria**
- **246 specimens, 459 blocks of embedded tissues from 17 species and 11 locations, 3600+ slides**
- **Bibliography of 996 citations and 352 reprints on coral disease** <http://mrl.cofc.edu/oxford/coralreprint.html>

Annotated Bibliography of Cnidarian Biochemistry

- >1870 references with abstracts, key words and annotations including journal articles, book sections, meeting reports, web source materials available as an ENDNOTE™ library and on CD
- Available at
http://www.coral.noaa.gov/coral_disease

Model Systems & Coral “Lab Rat” Facilities

Coral “lab rat” species for the disease research
community under development



Work in Progress.....

- ❖ Web Tool for Diagnosing Coral Disease
- ❖ Establish nomenclature review board to review data on newly described diseases
- ❖ “Diseases of Coral” - project accepted
- ❖ Special Edition of Marine Pollution Bulletin
- ❖ CDHC Pacific Workshop: *Vision for Action*.
- ❖ Rapid Response Teams

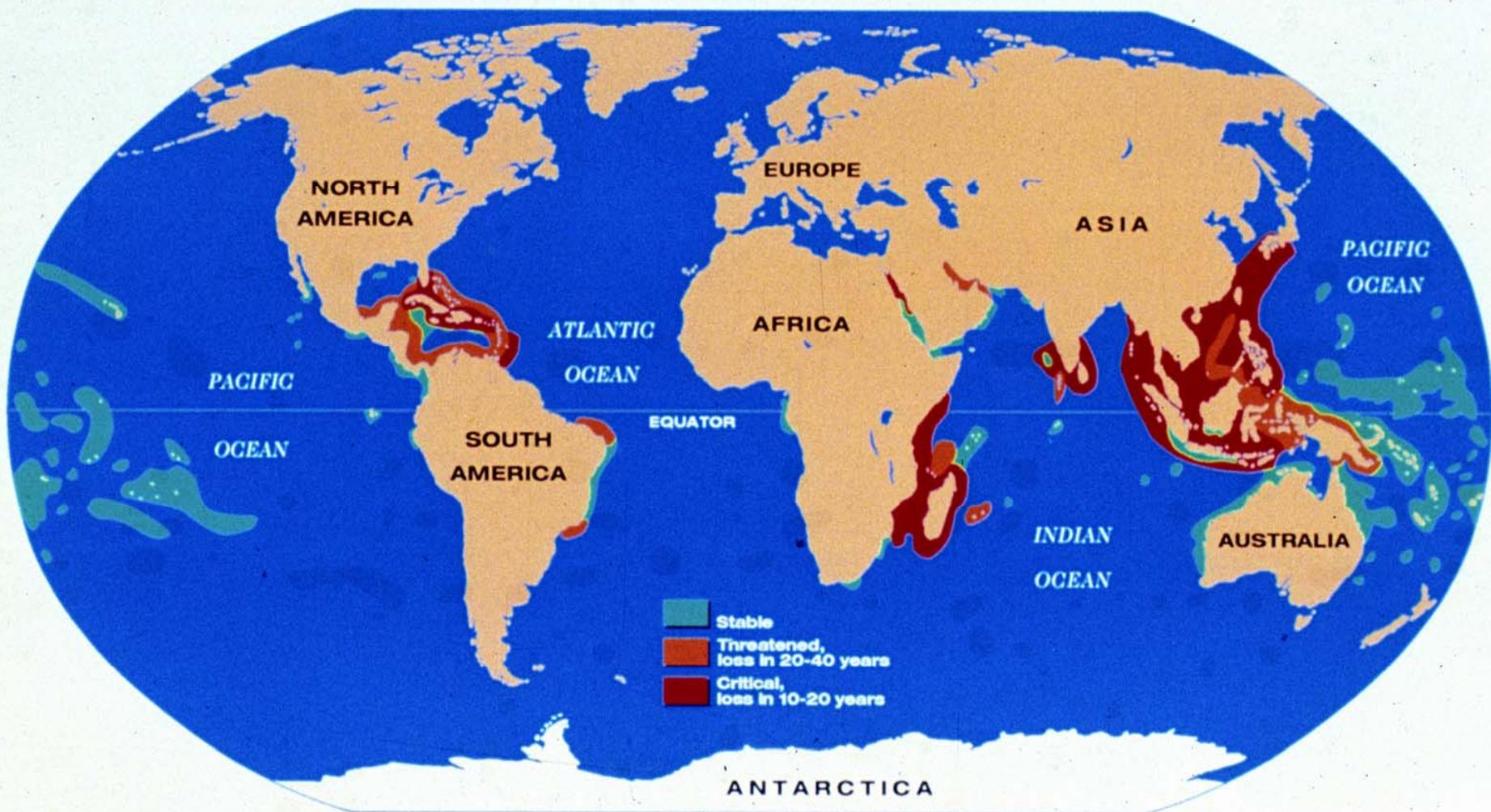
Education Resources

Education and Training

- **Coral Reef Toxicology Workshop 2005** Theme: Environmental Forensics
- **Univ of Hawaii's Pauley Program** – Theme: advanced techniques
- **Advanced Coral Histopathology** – Spring 2005
- **Diseases of Corals and other Reef Organisms** –Mote Marine Lab Summer Course
- **Rapid Response Teams** – conducting an unusual mortality event investigation



Epizootiologic Programs



Coral disease



Aspergillosis



Yellow band

Before 1996: 4 diseases described

2004: 29 diseases described



White pox

Black band



Dark spots

Florida Keys

1996-2000

stations w/ disease: 26 -> 131
coral species w/ disease: 11 -> 36
Overall coral cover: decreased by 37%

Porter et al. (2002)



Aspergillosis



Yellow band



White pox



Black band



Dark spots

Caribbean

Coral disease hotspot



Aspergillosis



Yellow band

Indo-Pacific

?



White pox

Black band



Dark spots

Indo-Pacific



Porites trematodiasis



Montipora tissue loss syndrome



Acropora white syndrome

American Samoa Hawaii
Australia Palau Johnston Atoll
Philippines Guam

Acropora growth anomalies



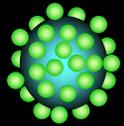
Porites brown necrotizing disease

Black band

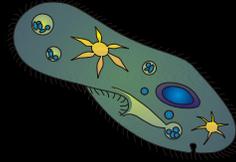


Agents of wildlife mortality

Infectious



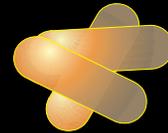
Viruses



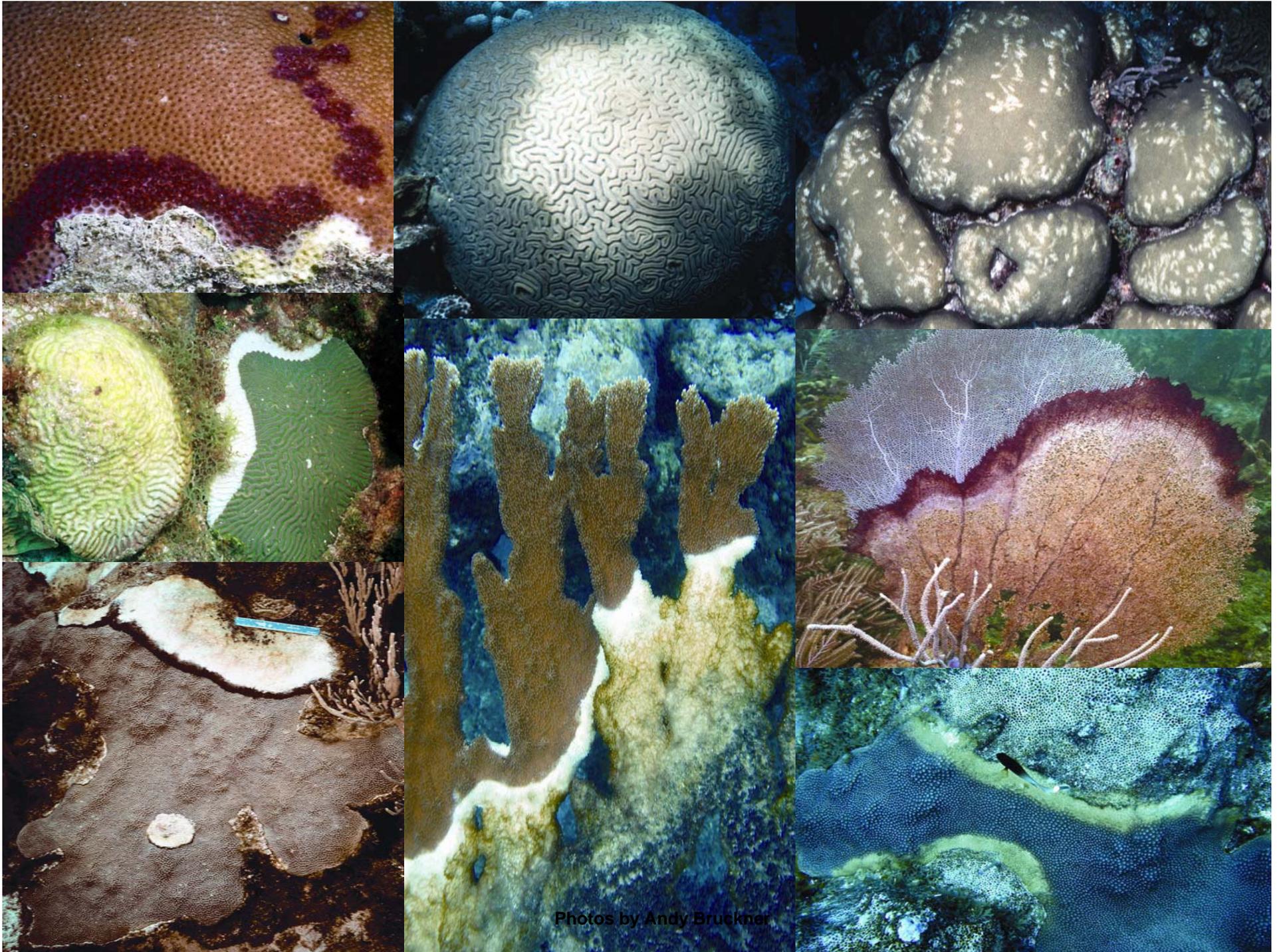
Parasites



Fungi



Bacteria



Photos by Andy Bruckner

Agents of wildlife mortality

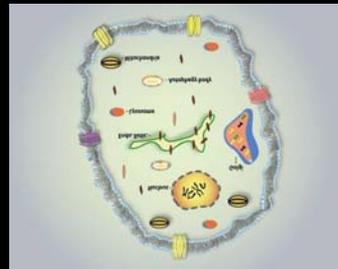
Non infectious



Toxins/toxicants



Trauma



Physiologic

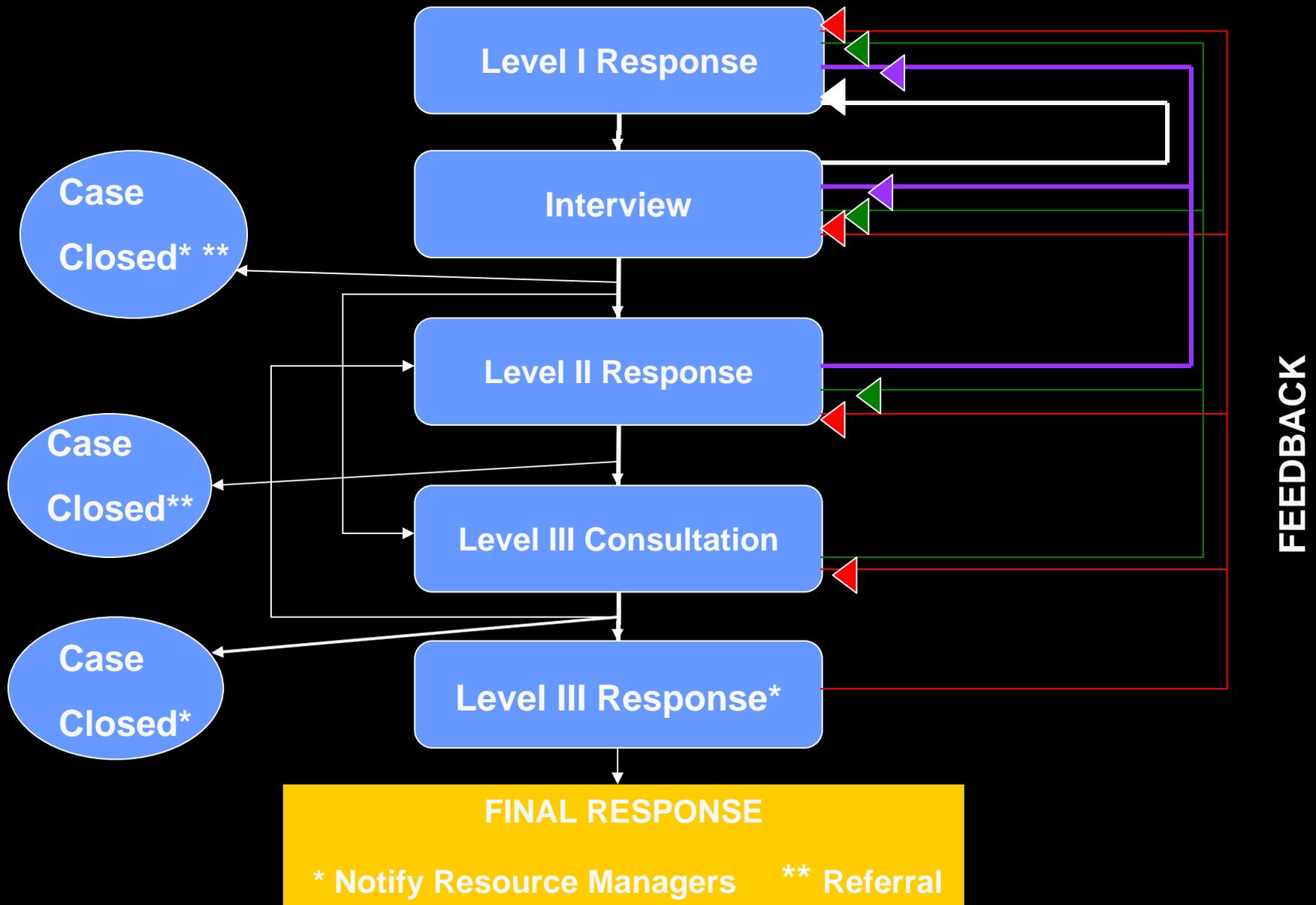


Leaking barrels
Vieques Island coral reef.



Rapid Response Teams

Coral Disease Investigation Decision Process



Coral Disease Investigation Decision Tree

Level I Response

Interview

Decision

Case Closed*

1. Already reported
2. Lack of credibility
3. Non-disease observation
4. Unable to contact observer

Level II Recommendation

1. New observation
2. Insufficient information
3. Species at risk (multiple)
4. Magnitude
5. Expansion earlier observation
6. Photograph/video details

Level III Consultation

1. Strength of observation
2. Magnitude supported by surveys, photos, prevalence data
3. Boat/staff in area with specific knowledge

Coral Disease Investigation Decision Tree

Level II Response

Decision

Case Closed*

1. Observations not field supported during Level II response
2. Within normal (known) background
3. Non-diseased agent (ie., boat trauma, anchor injury, hurricane damage)
4. Referral to another response team (bleaching, grounding, fish kills)
5. Adequate information obtained in Level II

Level III Consultation

1. Strength of observation
2. Magnitude: distribution, frequency, multiple species, proportion colonies affected higher than expected, higher than expected mortality rates
3. New/unusual condition
4. Temporal irregularity
5. Relative importance of species at risk
6. Population/Community impacts

*Final Response to Closed Cases

1. Referral
2. Notify Resource Managers

Level III Response

1. Activate Rapid Response Team
2. Notify Resource Managers

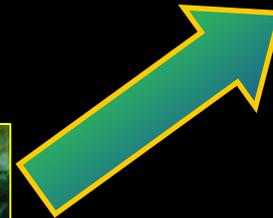
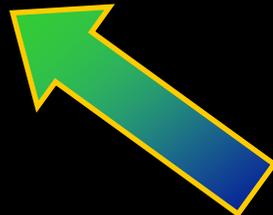
The two phases of an investigation



Field



Laboratory



Landscapes

Ecosystems

Communities

Species

Populations

Individuals

Organs

Tissues

Cells &

Molecules

Ecological
monitoring

Ecotoxicology

Cellular
Physiology

Histology

Proteomics

Genomics

Abiotic stressors



Disease Investigations

Field Observations

- Phone call from field observer, sent photos and description

Sampling Planning meetings to discuss:

- Number and type of samples
- Number of sampling sites
- Coordination with field researchers

Preparation for sampling trip

- Gather supplies required to take samples
- Pack equipment/reagents necessary for microbiology, DNA, RNA, and protein experiments

Sample Collection & Processing

- Each sample is collected with a purpose in mind
- Samples processing occurs in the field to maximize sample integrity

Microbiology

DNA

Culturing

RNA

Subtractive
Libraries

Protein

2-D
Electrophoresis

Histology

Coral Tissue
Bank

OUTBREAK INVESTIGATION

- Field Investigation
 - **Gathering 'case history' data**
 - **Ecological data**
 - prevalence, species affected and unaffected, extent of area affected
 - **Diagnostic Data and Sample Collection**
 - Lesion size, color, shape, distribution

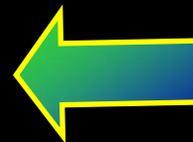
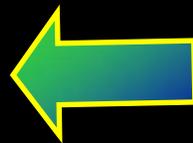
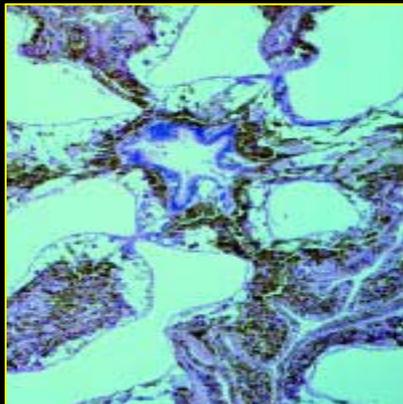
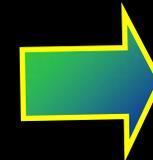
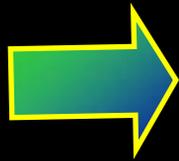


OUTBREAK INVESTIGATION

- **Laboratory Investigations include**
 - **Histopathology**
 - **Traditional microbiology**
 - **Molecular microbiology**
 - **Cellular diagnostics**
 - **Proteomics**
 - **Toxicology (if indicated)**
 - **Environmental epidemiology**



Pathology



Molecular microbiology
Cellular Diagnostics
Proteomics



DATA



INFORMATION



KNOWLEDGE

What's Next?

- Pilot test Levels I-III Response Protocols
- Finalize Response Protocol Manual
- Develop Communication and Media Plan
- Establish Regional Coordinators and Response Teams
- Conduct training for Response Teams
- Develop Database for Epizootiology

What's Next?

o **Develop Outreach Plan**

- o Work with response agencies to establish reporting network for Level I response
- o Work with local representatives to the CRTF to develop coral disease local action strategies
- o Assist coral monitoring programs incorporate health and disease in survey efforts

o **Develop educational and training materials**

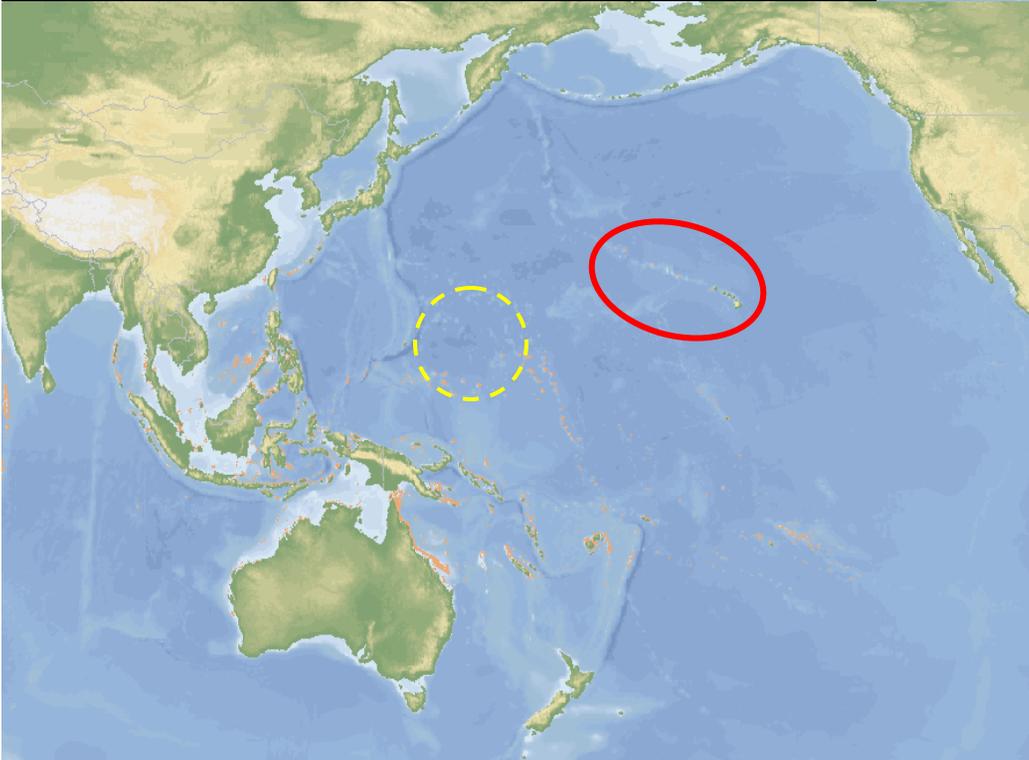
- o Increase local coral disease expertise and response capabilities

o **Develop strategy for contingency funding**

Establish Regional Response Capabilities

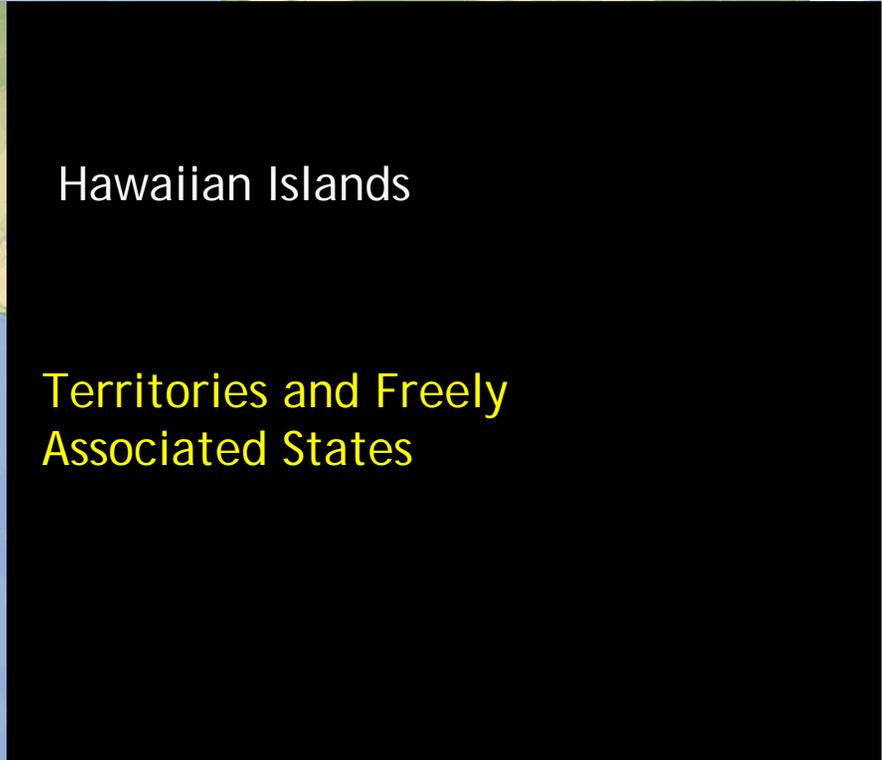
South Florida &
Flower Garden Banks

Caribbean



Hawaiian Islands

Territories and Freely
Associated States



Coral Health and Disease: Developing a National Plan

Our lack of understanding of the underlying mechanisms of coral pathologies inhibits our ability to manage the growing coral health problems.....

Identifying the factors responsible for coral health decline and increased disease incidence, requires embracing a **new paradigm of scientific investigation** that uses new methods and new technologies that allows us to understand the mechanisms that link cause and effect relationships.....

- Please visit our website for continuing updates and new products from the

Coral Disease and Health Consortium

http://www.coral.noaa.gov/coral_disease/cdhc.html